INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

N99/410/H(3)

BIOLOGY

Higher Level

Thursday 11 November 1999 (morning)

Paper 3 — 1 hour 15 minutes

A

Candidate name:	Candidate category & number:

This examination paper consists of 5 Options.
The maximum mark for this paper is 40.

INSTRUCTIONS TO CANDIDATES

Write your candidate name and number in the boxes above.

Do NOT open this examination paper until instructed to do so.

Answer ALL of the questions from TWO of the Options in the spaces provided.

At the end of the examination, complete box B below with the letters of the Options answered.

B

OPTIONS ANSWERED

C

EXAMINER	TEAM LEADER
/20	/20
/20	/20
TOTAL /40	TOTAL /40

D

IBCA
/20
/20
TOTAL /40

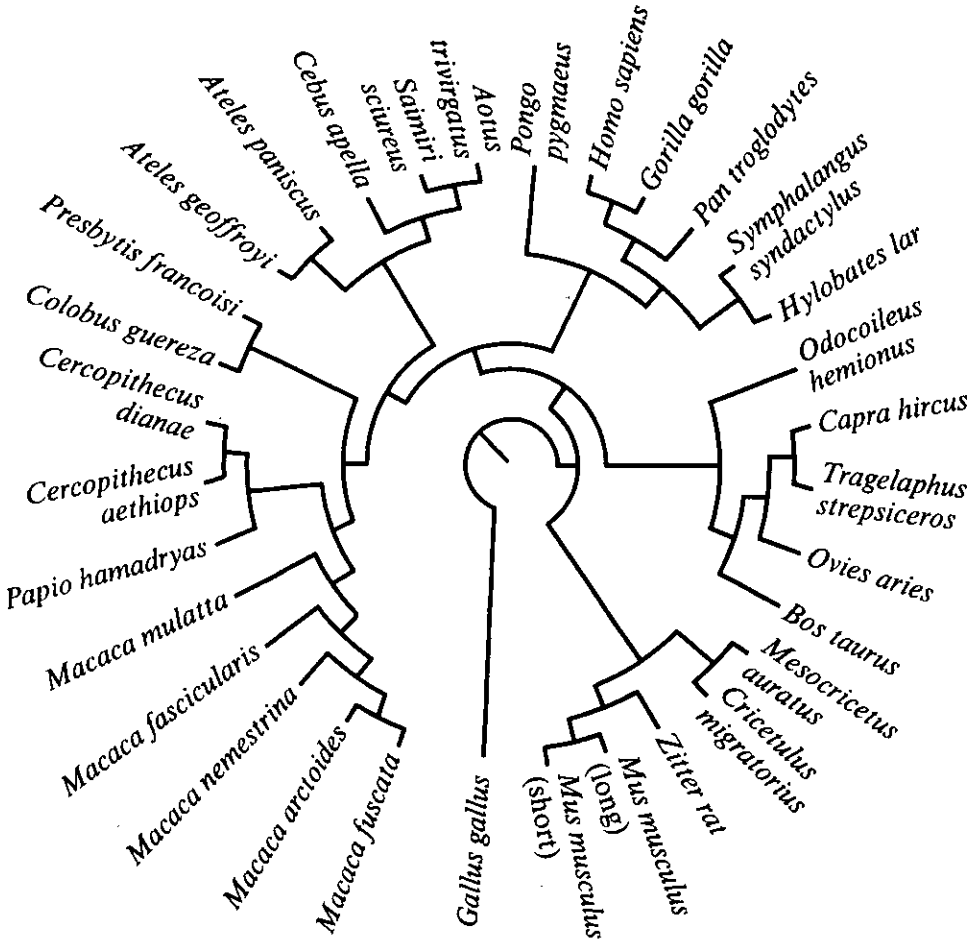
EXAMINATION MATERIALS

Required:
Calculator

Allowed:
A simple translating dictionary for candidates not working in their own language

Option D — Evolution

D1. Prion protein is found on the surface of neurons in vertebrates. The gene coding for this protein has been sequenced in 33 species of vertebrate. The differences in base sequence have been used to construct a phylogeny for these 33 vertebrates. The phylogeny is shown in the diagram below.



[Source: Krakauer *et al*, *Nature* (1996), 380, page 675]

(a) Deduce the species in which the base sequence of the gene is

(i) most **similar** to that of *Homo sapiens* *[1]*

.....

(ii) most **different** from that of *Homo sapiens.* *[1]*

.....

(This question continues on the following page)

(Question D1 continued)

In the evolution of *Homo sapiens*, two mutations caused amino acid substitutions in prion protein (tyrosine to histidine at site 155 and asparagine to serine at site 143). These two amino acid substitutions are also found in *Gorilla gorilla*, *Pan troglodytes*, *Symphalangus syndactylus* and *Hylobates lar*.

(b) Deduce where, in the evolution of *Homo sapiens*, these two mutations happened. Show your answer by drawing an arrow **on the diagram opposite**. *[1]*

(c) *Bos taurus* (cattle) is the only other species with the same two amino acid substitutions. Suggest why the same amino acid substitutions are present in *Bos taurus* as in the other five species. *[2]*

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Prion protein becomes altered in fatal brain diseases called spongiform encephalopathies. Humans may develop spongiform encephalopathy as a result of eating prion protein from cattle but not sheep *(Ovies aries)* infected with the disease.

(d) Predict how humans might evolve if they continued to eat prion protein from cattle infected with spongiform encephalopathy. *[1]*

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D2. (a) Outline **two** of the advantages of the evolution of bipedalism in humans. *[2]*

1 . . . . . .

. . . . . .

2 . . . . . .

. . . . . .

(b) Suggest **one** advantage and **one** disadvantage of the evolution of large brain size in humans. *[2]*

advantage . . . . . .

. . . . . .

disadvantage . . . . . .

. . . . . .

D3. (a) Compare the conditions on Earth now with those before the origin of life. *[6]*

(b) Discuss whether acquired characteristics can be inherited. *[4]*

Option E — Neurobiology and Behaviour

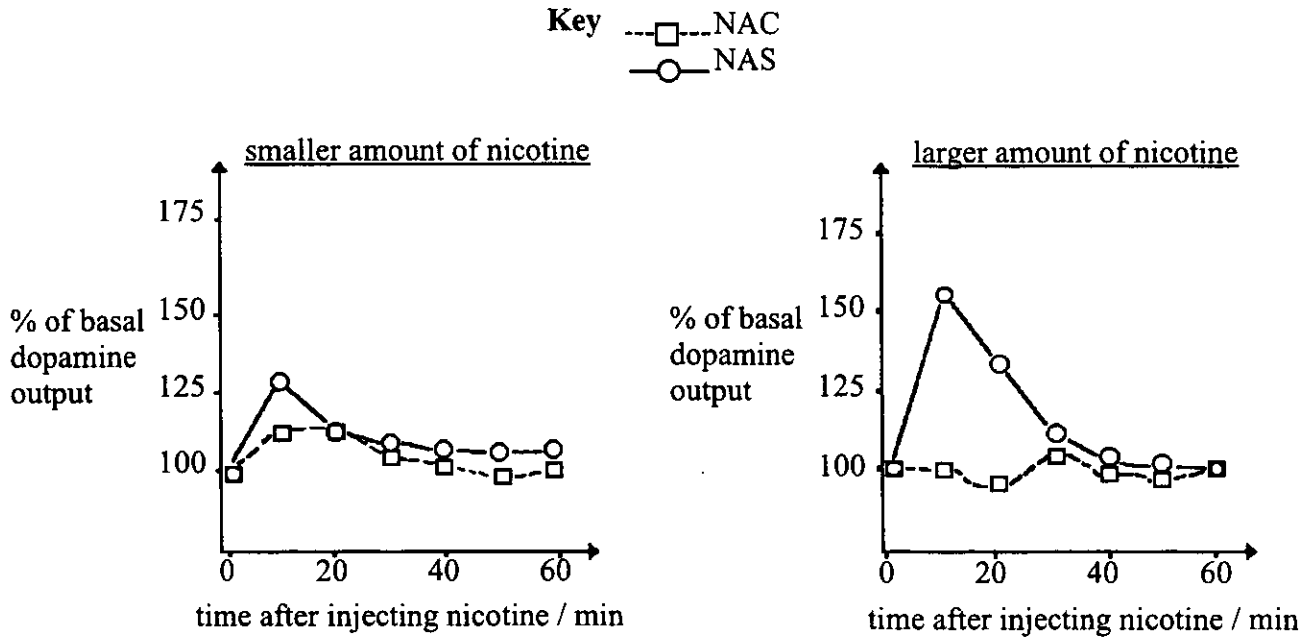
E1. (a) Describe the migration of a named species of bird **or** mammal. *[6]*

(b) Explain the role of natural selection in the development of migration in birds **or** mammals. *[4]*

E2. Cocaine, amphetamine and morphine are strongly addictive drugs. They have effects on an area of the brain concerned with the integration and expression of emotions, the NAS (nucleus accumbens shell). They cause an increase in energy use and in production of dopamine (a neurotransmitter).

There has been much discussion about whether nicotine is an addictive drug or not. Neurobiologists recently performed two experiments on rats to try to obtain evidence. In the first experiment nicotine was injected into the veins of rats. Glucose absorption in thirty seven areas of the brain was then measured. The only area to show a significant increase compared to control rats was the NAS.

In a second experiment the neurobiologists injected either a smaller or a larger amount of nicotine into the rats' veins, and measured dopamine production in the NAS. As a control they also measured dopamine production in a nearby area of the brain, NAC (the nucleus accumbens core). The results of the second experiment are shown below.



[Source: Pontieri *et al*, *Nature* (1996), 382, pages 255–257]

(a) Using only the data in the graphs, compare the effect on the NAS of injecting the larger amount of nicotine with the effect of injecting the smaller amount of nicotine. *[2]*

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(This question continues on the following page)

(Question E2 continued)

(b) Explain the evidence from the two experiments which supports the hypothesis that smoking tobacco causes nicotine addiction. *[2]*

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(c) Suggest **two** arguments that tobacco companies could use to question whether the experiments support the hypothesis that smoking tobacco causes nicotine addiction. *[2]*

1 . . . . . .

. . . . . .

2 . . . . . .

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E3. (a) State **one** example of an animal that shows social behaviour. *[1]*

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(b) Discuss briefly whether behaviour of animals in social organisations is altruistic. *[3]*

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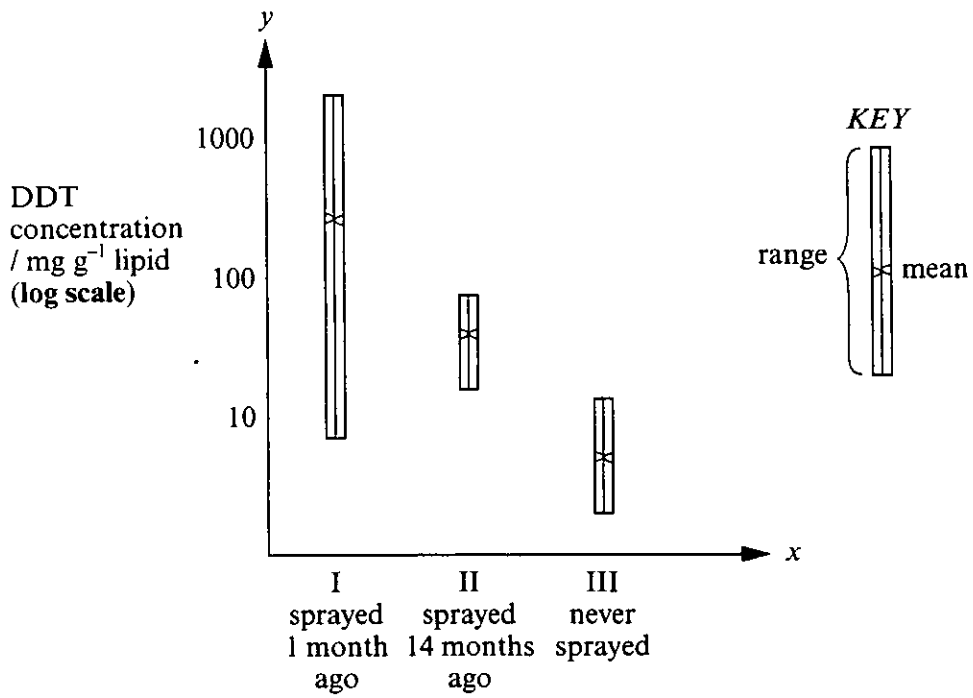
Option F — Applied Plant and Animal Science

F1. In an attempt to control tsetse flies (an insect pest of cattle) a programme of spraying with DDT insecticide was carried out in Zimbabwe. Specimens of a bird (*Thamnolaea arnoti*) that feeds on insects were collected from three areas (I, II and III) that are close together. The DDT content of the body lipids of the birds was measured. The range and the mean results are shown below, with the time since each area was sprayed.



[Source: Douthwaite, *Journal of Applied Ecology* (1995), 32, pages 727–738]

(a) (i) Compare the DDT levels in *T. arnoti* from area I (sprayed one month ago) with those from area II (sprayed fourteen months ago). *[2]*

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. . . . . .

(ii) Suggest **two** reasons for the differences between DDT levels of *T. arnoti* collected from area I and DDT levels of *T. arnoti* collected from area II. *[2]*

1 . . . . . .

. . . . . .

2 . . . . . .

. . . . . .

(This question continues on the following pages)

(Question F1 continued)

(b) Suggest **one** reason for the presence of DDT in the birds from the area III. *[1]*

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. . . . . .

(c) DDT levels were also measured in other species of bird in the sprayed areas. Predict whether the levels of DDT were higher or lower than the levels in *T. arnoti* in: *[1]*

Plocepasse mahali (a seed eating bird) . . . . . .

Accipiter tachiro (a bird of prey) . . . . . .

F2. (a) Outline **one** example of how world food problems can be reduced by improvements in food storage. *[2]*

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(b) Suggest **two** reasons for imbalances in food production and food need in regions of the world. *[2]*

1 . . . . . .

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2 . . . . . .

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F3. (a) Describe how plants are cloned by micropropagation. *[6]*

(b) Explain the biological principles in the use of hormone weedkillers. *[4]*

Option G — Ecology and Conservation

G1. (a) Outline the changes that occur during primary succession in an ecosystem. *[6]*

(b) Explain how water affects the distribution of plant species. *[4]*

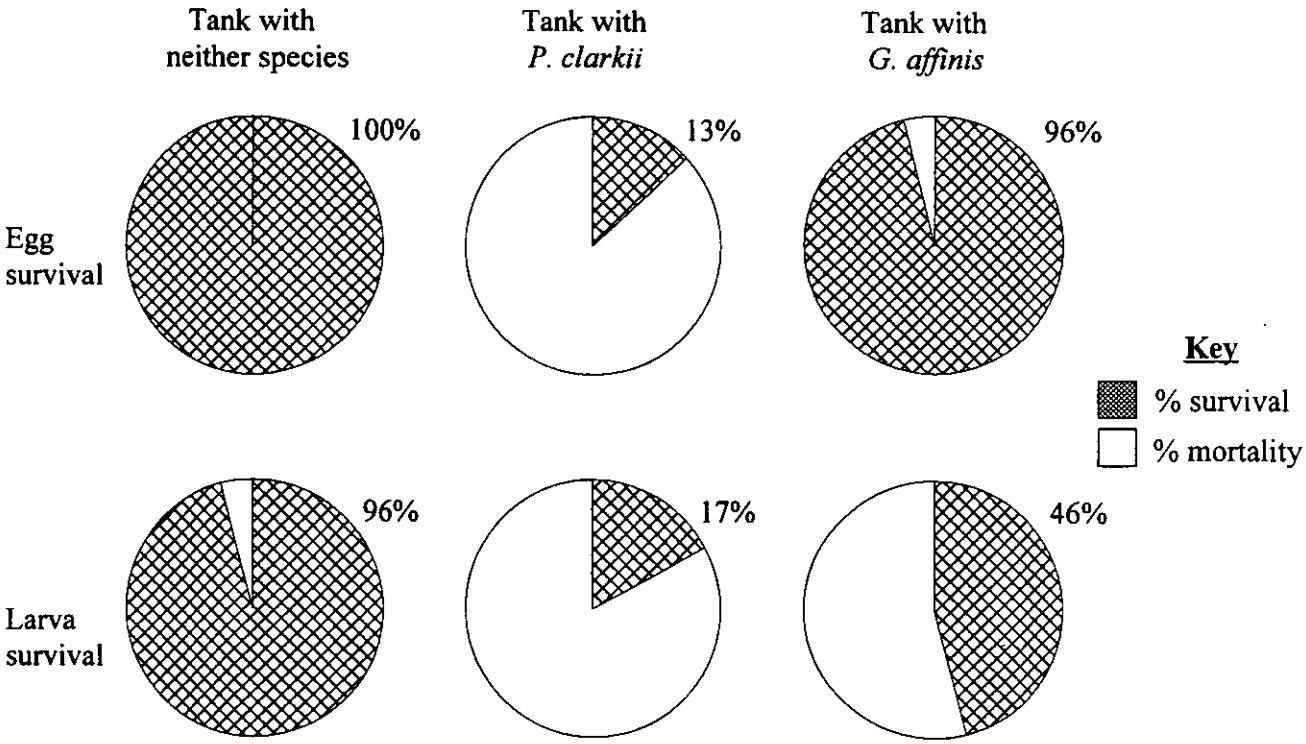
G2. The California newt, *Taricha torosa,* has disappeared from many of the rivers where it lived. Two alien species recently introduced to rivers in southern California may be the cause. One of them is a fish, *Gambusia affinis*, which was introduced to control mosquito larvae. The other is a crustacean, *Procambarus clarkii,* which can be eaten by humans. *Taricha torosa* is no longer found in any river where either of the alien species have been introduced.

(a) Suggest **two** interactions between *G. affinis* or *P. clarkii* and *Taricha torosa* which could cause *Taricha torosa* to disappear. *[2]*

1 .....

2 .....

A laboratory experiment was done to investigate these interactions. Three aquarium tanks were set up. The first tank contained neither of the alien species. The second tank contained one live specimen of *P. clarkii* and the third one contained one live specimen of *G. affinis*. Each day during the experimental period, either a group of *Taricha torosa* eggs or a group of *Taricha torosa* larvae were put into each tank. The pie charts below show percentage survival rates after one day.



[Source: Gamradt and Kats, *Conservation Biology* (1996), 10, pages 1–9]

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(Question G2 continued)

(b) Explain which of the interactions suggested in (a) is more likely to have caused the results of the experiment. *[1]*

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(c) Using the data in the pie charts, predict with reasons which species will cause *Taricha torosa* to disappear more rapidly from a river. *[2]*

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(d) Suggest **one** method of controlling the alien species which will not cause further damage to river communities. *[1]*

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G3. Condensation, precipitation and drainage are three processes that form part of the water cycle.

(a) List **two other** processes that form part of the water cycle. *[2]*

1 . . . . . .

2 . . . . . .

(b) Precipitation is very acidic in some regions of the world. Outline the causes of acid precipitation. *[2]*

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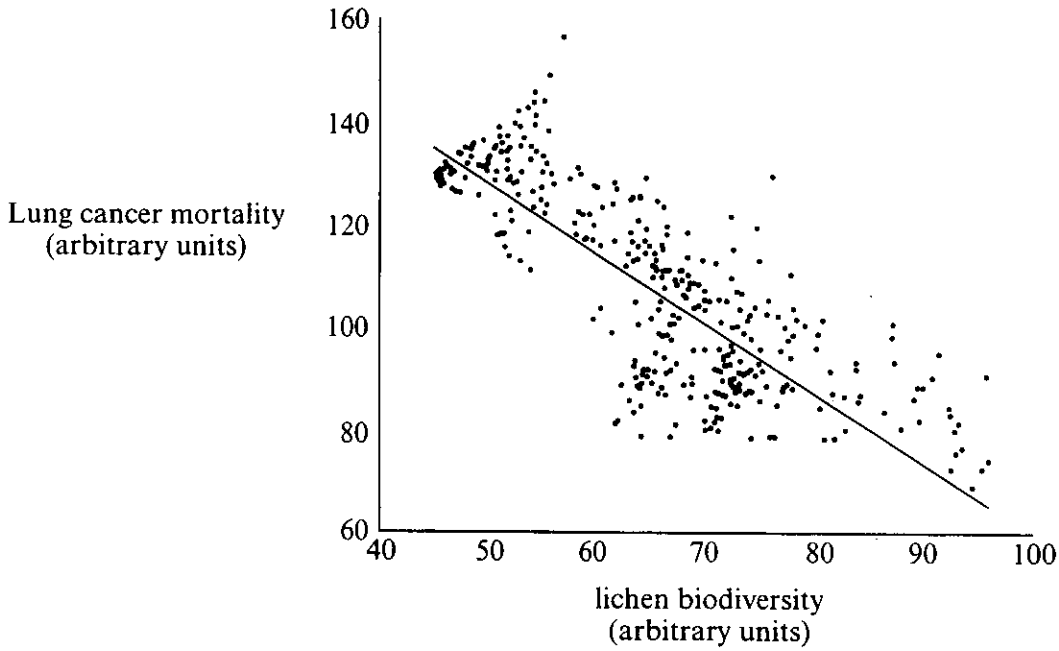
Option H — Further Human Physiology

H1. The causes of lung cancer were investigated by researchers in Italy using lichens. Lichens grow on the trunks of trees and vary in their ability to grow in polluted air. As air becomes more polluted fewer species of lichen are able to survive, so lichen biodiversity falls. Mortality due to lung cancer in men was found in each municipality in the Veneto region of north east Italy, using medical records. The biodiversity of lichens growing in each municipality was then measured. The results are shown in the scattergram below.



[Source: Cislaghi and Nimis, *Nature* (1997), 387, page 463]

(a) (i) Using only the data in the scattergram, identify the relationship between mortality due to lung cancer and lichen biodiversity in the Veneto region. *[1]*

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(ii) Explain the relationship between mortality due to lung cancer and lichen biodiversity. *[2]*

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(Question H1 continued)

(b) Only men who had lived in one municipality for their entire life were included in the investigation. Suggest **one** reason for excluding other men. *[1]*

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(c) Suggest **two** reasons for the points on the scattergram not all lying on the line of best fit. *[2]*

1 . . . . . .

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2 . . . . . .

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H2. (a) Outline how the atria of the heart are stimulated to contract. *[2]*

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(b) Explain the origin of the heart sounds. *[2]*

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H3. (a) Outline the circulation of blood through the liver, including the vessels that supply and carry away blood. *[6]*

(b) Explain the need for the liver to regulate levels of nutrients in the blood. *[4]*